AMENDMENTS TO THE CLAIMS

Listing of the claims:

Following is a listing of all claims in the present application, which listing supersedes all previously presented claims:

1. (Currently Amended) A simulator system having computer-aided design programs for simulating a shift control algorithm for ~~stored in a shift controller of~~ an automatic transmission of ~~mounted on~~ a vehicle~~, said vehicle~~ having a hydraulic actuator to transmit power generated by an internal combustion engine to drive wheels ~~based on at least throttle opening and vehicle speed~~ in accordance with the shift control algorithm, comprising:

a control system design tool ~~connected to the shift controller~~ for inputting the shift control algorithm and for outputting a hydraulic pressure supply command as a pseudo signal such that the hydraulic pressure supply command is supplied to the hydraulic actuator through a hydraulic circuit based on a shift signal from the shift control algorithm;

a first simulator section connected to the control system design tool for inputting the hydraulic pressure supply command and for estimating an effective hydraulic pressure generated in the hydraulic actuator in response to the hydraulic pressure supply command based on a first model; ~~and~~

a second simulator section connected to the control system design tool and to the first simulator section for determining transfer functions of a second model describing behavior of the hydraulic actuator such that an output of the second model converges with the estimated effective hydraulic pressure; and~~,~~

~~wherein the second simulator section simulates and evaluates the shift control algorithm based on~~ a third model obtained by incorporating the second model with the first model, wherein the second simulator section simulates and evaluates the shift control algorithm based on the third model.

2. (Currently Amended) The simulator system according to claim 1, further including:

a host computer for designing the second model and for storing data such that the second simulator section determines the transfer functions by retrieving the stored data by a predetermined parameter.

3. (Currently Amended) The simulator system according to claim 1, wherein the transfer functions include at least one transfer function that corresponds to a predetermined period of time at which the output of the second model begins to increase.

4. (Currently Amended) The simulator system according to claim 3, wherein the second model generates the output when an input of the second model exceeding a predetermined value is greater than the predetermined period of time.

5. (Currently Amended) The simulator system according to claim 1, wherein the transfer functions include at least one transfer function which is multiplied to an input of the second model such that the output of the second model converges with the estimated effective hydraulic pressure.

6. (Currently Amended) The simulator system according to claim 2, wherein the predetermined parameter is at least one of a fluid temperature of the transmission, a

rotational speed of the hydraulic actuator, the hydraulic supply command and a shift interval.

7. (Currently Amended) A simulator system having computer-aided design programs for simulating a shift control algorithm for ~~stored in a shift controller of~~ an automatic transmission of ~~mounted on~~ a vehicle~~, said vehicle~~ having a hydraulic actuator to transmit power generated by an internal combustion engine to drive wheels ~~based on at least throttle opening and vehicle speed~~ in accordance with the shift control algorithm, comprising:

transmission characteristic analyzing means for analyzing characteristics of the transmission when a shift is assumedly conducted in accordance with the shift control algorithm through a value to determine deviation of the characteristics from a predetermined standard;

parameter extracting means for extracting a parameter having influence on the characteristics when durability of the transmission is degraded;

undesirable shift phenomenon forecasting means for conducting simulation based on a model, while changing the parameter and forecasting occurrence of undesirable phenomenon using the value based on behavior change of the model; and

algorithm correcting means for correcting the shift control algorithm based on a result of forecasting such that the forecasted occurrence of undesirable phenomenon disappears.

8. (Currently Amended) The simulator system according to claim 7, wherein the algorithm correcting means corrects the shift control algorithm by repeating the simulation until the forecast occurrence of undesirable phenomenon disappears.

9. (Currently Amended) The simulator system according to claim 7, further including:

a data base for storing the behavior change of the model when the parameter is changed.

10. (Currently Amended) The simulator system according claim 7, wherein the algorithm correcting means corrects at least part of the shift control algorithm based on a result of the forecast.

11. (Currently Amended) The simulator system according to claim 7, wherein the parameter is at least one of a fluid temperature of the transmission, a clearance of the hydraulic actuator, and a friction coefficient of the hydraulic actuator.

12. (Currently Amended) A simulator system having computer-aided design programs for simulating a shift control algorithm for ~~stored in a shift controller of~~ an automatic transmission of ~~mounted on~~ a vehicle~~, said vehicle~~ having a hydraulic actuator to transmit power generated by an internal combustion engine to drive wheels ~~based on at least throttle opening and vehicle speed~~ in accordance with the shift control algorithm, comprising:

a control system design tool ~~connected to the shift controller~~ for inputting the shift control algorithm and for outputting a hydraulic pressure supply command as a pseudo signal such that the hydraulic pressure supply command is supplied to the hydraulic actuator through a hydraulic circuit based on a shift signal from the shift control algorithm;

a first simulator section connected to the control system design tool for inputting the hydraulic pressure supply command and for estimating an effective hydraulic

pressure generated in the hydraulic actuator in response to the hydraulic pressure supply command based on a first model; and

a second simulator section connected to the control system design tool and to the first simulator section for determining transfer functions of a second model describing behavior of the hydraulic actuator such that an output of the second model converges with the estimated effective hydraulic pressure, the second simulator section simulates and evaluates the shift control algorithm based on a third model obtained by incorporating the second model with the first model,

wherein the second simulator section includes:

transmission characteristic analyzing means for analyzing characteristics of the transmission when a shift is assumedly conducted in accordance with the shift control algorithm through a value to determine deviation of the characteristics from a predetermined standard;

parameter extracting means for extracting a parameter having influence on the characteristics when durability of the transmission is degraded;

undesirable shift phenomenon forecasting means for conducting simulation based on the third model, while changing the parameter and forecasting occurrence of undesirable phenomenon using the value based on behavior change of the third model; and

algorithm correcting means for correcting the shift control algorithm such that the forecasted occurrence of undesirable phenomenon disappears.

13. (Currently Amended) The simulator system according to claim 12, wherein the algorithm correcting means corrects the shift control algorithm by repeating the simulation until the forecast occurrence of undesirable phenomenon disappears.

14. (Canceled)

15. (Currently Amended) The simulator system according to claim 12, further including:

a data base for storing the behavior change of the third model when the parameter is changed.

16. (Currently Amended) The simulator system according to claim 12, wherein the algorithm correcting means corrects at least part of the shift control algorithm based on a result of the forecast.

17. (Currently Amended) The simulator system according to claim 12, wherein the parameter is at least one of a fluid temperature of the transmission, a clearance of the hydraulic actuator, and a friction coefficient of the hydraulic actuator.

18. (Currently Amended) A method for simulating a shift control algorithm for ~~stored in a shift controller of~~ an automatic transmission of ~~mounted on~~ a vehicle~~, said vehicle~~ having a hydraulic actuator to transmit power generated by an internal combustion engine to drive wheels ~~based on at least throttle opening and vehicle speed~~ in accordance with the shift control algorithm, said method comprising the steps of:

(a) inputting the shift control algorithm to output a hydraulic pressure supply command as a pseudo signal to be supplied to the hydraulic actuator through a hydraulic circuit based on a shift signal in the inputted shift control algorithm;

(b) inputting the hydraulic pressure supply command and estimating an effective hydraulic pressure generated in the hydraulic actuator in response to the hydraulic pressure supply command based on a first model

(c) determining transfer functions of a second model such that an output of the second model converges with the estimated effective hydraulic pressure; and

(d) simulating and evaluating the shift control algorithm based on a third model obtained by incorporating the second model with a hydraulic circuit of the first model.

19. (Currently Amended) The method according to claim 18, further including the step of:

(e) designing the second model and storing data such that the transfer functions are ~~is~~ determined by retrieving the stored data by a predetermined parameter.

20. (Currently Amended) The method according to claim 18, wherein the transfer functions include ~~includes~~ a first transfer function corresponding to a predetermined period of time at which the output of the second model begins to increase.

21. (Previously Presented) The method according to claim 20, wherein the second model generates the output when an input of the second model exceeding a predetermined value is greater than the predetermined period of time.

22. (Currently Amended) The method according to claim 18, wherein the transfer functions include ~~includes~~ at least one transfer function which is multiplied to an input of the second model such that the output of the second model converges with the estimated effective hydraulic pressure.

23. (Previously Presented) The method according to claim 19, wherein the parameter is at least one of a fluid temperature of the transmission, a rotational speed of the hydraulic actuator, the hydraulic supply command and a shift interval.

24. (Currently Amended) A method for simulating a shift control algorithm for ~~stored in a shift controller of~~ an automatic transmission of ~~mounted on~~ a vehicle~~, said vehicle~~ having a hydraulic actuator to transmit power generated by an internal combustion engine to drive wheels ~~based on at least throttle opening and vehicle speed~~ in accordance with the shift control algorithm, said method comprising the steps of:

(a) analyzing characteristics of the transmission when it is assumed that a shift is conducted in accordance with the shift control algorithm through a value to determine deviation of the characteristics from a predetermined standard;

(b) extracting a parameter having influence on the characteristics when durability of the transmission is degraded;

(c) conducting simulation based on a model, while changing the parameter and forecasting occurrence of undesirable phenomenon using the value based on behavior change of the model; and

(d) correcting the shift control algorithm based on a result of forecasting such that the forecasted occurrence of undesirable phenomenon disappears.

25. (Previously Presented) The method according to claim 24, wherein the step (d) corrects the shift control algorithm by repeating the simulation until the forecast occurrence of undesirable phenomenon disappears.

26. (Previously Presented) The method according to claim 24, further including the step of:

(e) storing the behavior change of the model when the parameter is changed.

27. (Previously Presented) The method according claim 24, wherein the step (d) corrects at least part of the shift control algorithm based on a result of the forecast.

28. (Previously Presented) The method according to claim 24, wherein the parameter is at least one of a fluid temperature of the transmission, a clearance of the hydraulic actuator, and a friction coefficient of the hydraulic actuator.

29. (Currently Amended) A method for simulating a shift control algorithm for ~~stored in a shift controller of~~ an automatic transmission of ~~mounted on~~ a vehicle~~, said vehicle~~ having a hydraulic actuator to transmit power generated by an internal combustion engine to drive wheels ~~based on at least throttle opening and vehicle speed~~ in accordance with the shift control algorithm, said method comprising the steps of:

(a) inputting the shift control algorithm to output a hydraulic pressure supply command as a pseudo signal to be supplied to the hydraulic actuator through a hydraulic circuit based on a shift signal in the inputted shift control algorithm;

(b) inputting the hydraulic pressure supply command and estimating an effective hydraulic pressure generated in the hydraulic actuator in response to the hydraulic pressure supply command based on a first model describing the entire system including the transmission; and

(c) determining transfer functions of a second model describing behavior of the hydraulic actuator such that an output of the second model converges with the estimated effective hydraulic pressure, and simulating and evaluating the shift control algorithm based on a third model obtained by incorporating the second model with the hydraulic circuit of the first model,

wherein the step (c) includes the steps of:

(d) analyzing characteristics of the transmission when it is assumed that a shift is conducted in accordance with the shift control algorithm through a value to determine deviation of the characteristics from a predetermined standard;

(e) extracting a parameter having influence on the characteristics when durability of the transmission is degraded;

(f) conducting simulation based on the third model, while changing the parameter and forecasting occurrence of undesirable phenomenon using the value based on behavior change of the third model; and

(g) correcting the shift control algorithm based on a result of forecasting.

30. (Previously Presented) The method according to claim 29, wherein the step (g) corrects the shift control algorithm by repeating the simulation until the forecast occurrence of undesirable phenomenon disappears.

31. (Canceled)

32. (Previously Presented) The method according to claim 29, further including the step of:

(h) storing the behavior change of the third model when the parameter is changed.

33. (Previously Presented) The method according to claim 29, wherein the step (g) corrects at least part of the shift control algorithm based on a result of the forecast.

34. (Previously Presented) The method according to claim 29, wherein the parameter is at least one of a fluid temperature of the transmission, a clearance of the hydraulic actuator, and a friction coefficient of the hydraulic actuator.

35. (New) A simulator system having computer-aided design programs for simulating a shift control algorithm for an automatic transmission of a vehicle having a hydraulic actuator to transmit power generated by an internal combustion engine to drive wheels in accordance with the shift control algorithm, comprising:

a test model hydraulic circuit design model conducting a test to obtain clutch pressure during an assumed shift of the automatic transmission in accordance with the shift control algorithm;

a shift simulation model analyzing a result of the test;

a simplified hydraulic model having transfer functions determined by the result of the test;

a real-time shift simulation model incorporating the simplified hydraulic model with the shift simulation model and determining characteristics inherent to the automatic transmission by evaluating the shift control algorithm through simulation, extracting parameters having influence on degradation of the automatic transmission, performing and repeating a durability simulation while changing parameters to forecast undesirable phenomenon during shifting, and correcting the shift control algorithm while repeating the durability simulation until the undesirable phenomenon disappear.

36. (New) A method for simulating a shift control algorithm for an automatic transmission of a vehicle having a hydraulic actuator to transmit power generated by an

internal combustion engine to drive wheels in accordance with the shift control algorithm, said method comprising the steps of:

designing a test model hydraulic circuit design model;

conducting a test using the test model hydraulic circuit design model to obtain a clutch pressure during an assumed shift of the automatic transmission in accordance with the shift control algorithm;

analyzing a result of the test using a shift simulation model;

designing a simplified hydraulic model based on the result of the test;

designing a real-time shift simulation model by incorporating the simplified hydraulic model with the shift simulation model;

conducting a simulation to evaluate the shift control algorithm using the real-time simulation model;

analyzing the shift control algorithm and determining characteristics inherent to the transmission using a result of the simulation;

extracting from the characteristics parameters having influence on degradation of the transmission;

preparing a durability simulation using the real-time shift simulation model;

repeating the durability simulation by changing the parameters to forecast undesirable phenomenon during shifting; and

correcting the shift control algorithm, while repeating the durability simulation, until the undesirable phenomenon disappear.